

## ***Chalinochromis cyanophleps*, a new species of cichlid fish (Teleostei: Cichlidae) from Lake Tanganyika**

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### **Abstract**

*Chalinochromis cyanophleps* is described from nine specimens, the largest 129 mm SL, from Namansi. It differs from other species of *Chalinochromis* in plain trunk colouration, absence of black stripes on the head, relatively narrow lips, presence of tricuspid jaw teeth, and presence of five rather than four dentary lateralis foramina. The blue iridescent stripe below the eye is shared with other lamprologin cichlids, but is broader and more conspicuous in *C. cyanophleps*. *Chalinochromis cyanophleps* occurs at depths between 6 and 45 m in rocky habitats along the Tanzanian coast of Lake Tanganyika, from Mvuna Island south to Kalala Island, a stretch of about 90 km. Field observations were made of specimens up to 18 cm total length. The COI DNA barcode sequence differs by 1.8% from that of *C. popelini*.

**Key words:** DNA Barcode, endemism, meristics, morphometry, taxonomy

### **Introduction**

The endemic Lake Tanganyika cichlid genus *Chalinochromis* Poll (1974) presently includes two species characterized by steep head profile and thick papillose lips. *Chalinochromis brichardi* Poll (1974) was described from near Magara in Burundi and is uniformly beige with black stripes on the head and has an approximately rounded caudal fin. *Chalinochromis popelini* Brichard (1989) from Moba on the Congo coast is beige with black horizontal stripes and has a more or less emarginate caudal fin (Brichard 1989; Konings 1998). Two additional forms have been recognized in aquarium literature, and are considered as either distinct species or colour variation in *C. brichardi* or *C. popelini*, viz. *C. "bifrenatus"* with horizontal stripes along the side, and *C. "ndobhoi"* with series of blotches along the side (Konings 1998).

In 1991 one of us discovered a rock-dwelling lamprologin cichlid at Ulwile Island on the Tanzanian coast of Lake Tanganyika, similar in shape to known species of *Chalinochromis*. It was distinguished by its larger size and colour pattern, which is almost uniformly dark, with a blue stripe below the eye and shimmering blue fins (Karlsson & Karlsson 2012). A longer, illustrated description of the species was given by Karlsson & Karlsson (2012), in which article it was referred to as *Chalinochromis* sp. "blue vein". Morphological analysis shows that the dark species from Ulwile Island departs significantly from both *C. brichardi* and *C. popelini* not only in colour but also in the shape of the mouth and dentition. The objective of this paper is to provide a formal description of the new species.

### **Material and methods**

Specimens were collected by scuba diving, using a net of 1x5 m, mesh size 10 mm, with float and bottom lead, and also small hand net. Specimens were fixed in formalin and preserved in 70% ethanol. Prior to fixation the right pelvic fin was removed from one specimen and placed in 95% ethanol for DNA analysis.

Measurements and counts were recorded as described by Roberts & Kullander (1994) and Kullander *et al.* (2012). The length of the caudal peduncle is measured from the base of the last ray of the anal fin to the middle of the base of the caudal fin. Scales in a longitudinal row include the scales of the upper lateral line followed by those of the horizontal row containing the lower lateral line, starting with the first scale in the oblique row (sloping rostrad and ventrad) next behind that containing the last scale of the upper lateral line. Lateral line scales on the caudal fin are not counted. Counts of lateral line scales include all scales up to the posteriormost canal-bearing scales in the upper lateral line, and to the anteriormost canal-bearing scale in the lower lateral line. That means that, especially in the lower lateral line, the count may include several scales from which neuromast pits or bone canals are absent. Vertebral counts and counts of fin rays in unpaired fins were taken from X-radiographs. Vertebral counts include the last half-centrum. Teeth were counted in the outer row on one side (predominantly the left side) of the upper and lower jaw. Counts of caudal-fin rays include unsegmented procurent rays, the marginal unbranched segmented ray, and the branched rays separated by periods, counts of upper and lower lobe separated by a plus sign. X-radiographs were made on Kodak X-omat V film using a Philips MG-105 low voltage X-ray unit.

Morphometric data were managed and analysed using IBM Statistics 21 (IBM 2012) except that the principal component analysis (PCA) of measurements was made using a separate procedure for component shearing, partialling out multivariate size residues from the second and further components as described by Humphries *et al.* (1981). The PCA analysis was made with log-transformed measurement data to tenth of a millimetre in a covariance matrix, and without rotation. DNA sequences were obtained as described by Fernholm *et al.* (2013).

Abbreviations: NLF0 = neurocranial lateral line foramen 0; SL = Standard length. Specimens and tissue samples studied are deposited in the Swedish Museum of Natural History, Stockholm (NRM).

Undescribed species are designated with the names commonly used in the aquarium trade, and in quotes to mark that they are not available as scientific names: *Chalinochromis* “ndobhoi”, and *C.* “bifrenatus”, the latter also known as “Kipili.”

### *Chalinochromis cyanophleps*, new species

(Figs. 1–5; Table 1)

**Type material.** Holotype. NRM 11993, adult female, 113.7 mm SL. Tanzania, Rukwa Region, Nkansi District, Lake Tanganyika, western shore of Namansi village, depth 5–10 m, 7°37'15"S, 30°39'24"E. 22 May 2008. M. Karlsson & M. Karlsson. Paratypes: All with same data as holotype. NRM 59606, adult female 111.2 mm SL; NRM 59607, 5 adult males, 103.3–129.3 mm SL, 2 adult females, 108.7–111.5 mm SL.

**Diagnosis.** Distinguished from *Chalinochromis brichardi* by flank colour brown to dark grey vs. beige or light grey (Fig. 1); dark brown (conspicuous blue in life) stripe below eye, vs. contrasting black vertical stripes on head (Fig. 1); iris and eye ring partly orange, vs. orange colour not or only faintly visible; opercular blotch absent vs. prominent (Fig. 1); black blotch posteriorly in dorsal fin absent vs. present (Fig. 1); dorsal and caudal fins dark with white dots vs. pale and dots absent (Fig. 1); black spot at pectoral-fin base absent vs. present (Fig. 1); more teeth in upper jaw (13–16 vs. 5–10 in hemiseries), and lower jaw (17–26 vs. 2–3 in hemiseries); and slender caudal peduncle (depth 9.9–10.7% SL vs. 11.6–12.4%). Distinguished from all other species of *Chalinochromis* by absence of stripes and blotches on head (vs. present); lips not folded over adjacent jaw and not callous or papillate on lip surface outside that close to teeth (vs. lips wide and folded over adjacent premaxilla and dentary, and more or less extensively papillose on aborad surfaces) (Fig. 2); presence of tricuspid inner teeth (vs. exclusively unicuspis); five mandibular lateralis foramina (vs. four). Distinguished from all species of *Altolamprologus*, *Lamprologus*, *Lepidiolamprologus*, *Neolamprologus*, *Paleolamprologus*, and *Variabilichromis* by number of dorsal-fin spines (22–23 vs. 14–20, occasionally 21); from all species of Congo River *Lamprologus* by first pelvic-fin ray longest (vs. second to third rays longest), and lateral line scales 37–39 vs. 29–37; from all species of *Telmatochromis* by dentition (inner teeth mostly unicuspis vs. only or predominantly tricuspid), posterodorsal corner of opercle rounded (vs. pointed), and upper jaw projecting (vs. jaws equal); from all species of *Julidochromis* by absence of bars and bands on body, and scales in longitudinal row 37–39 vs. 36 or less.

**Description.** Based on all specimens in type series. For general aspect, refer to Fig. 1. Measurements are summarised in Table 1. Elongate, moderately compressed laterally. Trunk anteriorly elliptic in cross section, posteriorly more compressed; sides vertical, dorsum and venter rounded. Head relatively short; frontal contour

steep, ascending straight or slightly curved, strongly curved above orbit, joining about straight dorsal-fin base contour. In both sexes a low soft swelling anterior to dorsal-fin origin. Interorbital space wide, convex; head contour well removed from orbit. Orbit lateral, in middle of head length, in dorsal half of head, well separated from mouth by deep lachrymal bone. Eye exposed in dorsal view of head, not exposed in ventral view of head. Ventral profile almost straight, horizontal; anal-fin base slightly ascending. Caudal peduncle contours slightly constricted at middle. Snout short, blunt. Mouth low, at ventral contour, relatively small, narrower than interorbital space; upper jaw protruding slightly before short lower jaw. Ascending processes of premaxilla not reaching orbit. Maxilla not reaching to vertical from anterior margin of orbit. Lower jaw articulation anterior to vertical from anterior margin of orbit. Nostril situated at one-third distance from orbital margin to tip of upper jaw. Lips (Fig. 2A) relatively narrow, thick; fold of lower lip broadly interrupted anteriorly. Lips smooth except close to teeth where surface beset with short papillae similar to tissue in toothed field of jaws.

**TABLE 1.** Standard length (in millimetres) and proportional measurements in percent of standard length of *Chalinochromis cyanophleps*. SD= standard deviation. Regression line parameters, a (intercept), b (slope) (where ANOVA  $p < 0.005$ ), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimetres.

	N	Min	Max	Mean	SD	r	a	b
SL (mm)	8	103.3	129.3	117.1	9.4			
Head length	8	30.4	32.5	31.1	0.7	0.963	2.243	0.292
Snout length	8	12.9	14.0	13.6	0.3	0.972	-2.211	0.155
Preorbital depth	8	7.0	8.4	7.7	0.5	0.898	-3.704	0.109
Body depth	8	21.4	24.1	23.0	0.8	0.912	0.751	0.224
Orbital diameter	8	7.0	8.0	7.5	0.4	0.824		
Interorbital width	8	8.7	9.9	9.3	0.4	0.942	-2.924	0.118
Pectoral-fin length	8	21.3	24.0	22.6	0.8	0.920	6.509	0.170
Upper jaw length	8	8.0	8.8	8.5	0.3	0.900	-0.118	0.086
Lower jaw length	8	7.9	9.0	8.5	0.5	0.868		
Caudal peduncle depth	8	9.9	10.7	10.3	0.3	0.949	0.858	0.096
Caudal peduncle length	8	16.9	20.3	18.2	1.1	0.766		
Last dorsal-fin spine length	8	13.3	15.4	14.5	0.6	0.823		

Dorsal-fin rays XXII.7 (1), XXII.8 (7), XXIII.7 (1). First dorsal-fin spine 1/3 length of last, inserted above opercle; spines subequal from sixth, gradually slightly longer to last spine; soft dorsal-fin rays all branched or first ray unbranched, gradually slightly longer to fifth or sixth, beyond which shorter; soft portion ending in acute tip at  $\frac{1}{4}$  to beyond middle of caudal fin. Anal-fin rays VI.6 (4), VII.7 (5). First anal-fin spine inserted opposite antepenultimate dorsal-fin spine; spines gradually increasing in length to last; soft anal-fin rays all branched, increasing in length to third or fourth ray, posterior rays shorter; soft portion ending in pointed or blunt tip at caudal-fin base or, usually at  $\frac{1}{4}$  to beyond middle of caudal fin. Pectoral-fin rays 12 (8), 13 (1). Pectoral fin short, not quite reaching to vertical from genital papilla; rounded, fifth ray longest. Pelvic fin long, reaching base of third or fourth anal-fin spine; pointed, outer branch or equally long branches of first ray longest, inner rays gradually shorter. Caudal-fin hind margin rounded or with short straight vertical apex or slightly indented medially. Caudal-fin rays viii.i.7+7.i.vii (5), viii.i.7+7.i.viii (2), ix.i.7+7.i.viii (1), ix.i.7+7.i.ix (1)

Scales in longitudinal row 37 (2), 38 (5), 39 (2). Trunk scales moderately large, ctenoid, with free margin. Cheek naked. Predorsal scales minute, cycloid, embedded in thick skin; squamation extending anteriorly to slightly posterior to orbits. Field of minute embedded, cycloid scales extended posteriorly on side between anterior part of dorsal fin and lateral line. Lateral chest scales minute, cycloid, embedded, squamation extended along abdominal side. Midline abdominal scales small, about half size of flank scales, with free margin, cycloid or weakly ctenoid; smaller cycloid scales around anus and genital papilla, and flanking beginning of anal fin. Anterior half of prepelvic area naked, posteriorly minute embedded cycloid scales. Upper lateral line distance from dorsal-fin base anteriorly at about 12–15, posteriorly at 1–1½ scales; reaching posteriorly to below last rays of dorsal fin, not

continued to caudal peduncle. Lateral line scales (upper/lower+pored scales) 29/9+17p, 29/10+15p, 29/10+17p, 29/11+17p, 30/11+18p, 31/13+13p, 32/10+8p, 32/12+17p, 33/10+15p, each count unique. Lower lateral line reaching forward to above spinous anal fin, anterior to that continued by scattered pored scales or short rows of pored scales reaching almost to cleithrum. Two rows of scales separating upper and lower lateral lines where overlapping above anal fin. Circumpeduncular scales 16 (9), of which 7 above and 7 below lateral lines.

Thick skin along dorsal-fin base, from anterior 1/3 or middle of fin base containing minute cycloid scales; minute cycloid scales in 1–2 rows basally on posterior interradial membranes of spinous portion and all of soft portion, at most extending along half of fin ray. Anal fin with similar basal squamation. Caudal fin covered by dense layer of minute ctenoid scales, leaving naked only posterior part of three middle interradial membranes, and posterior margin of fin. Scales absent from pelvic and pectoral fins.

Gill rakers sparse, short, slender, villiform, 0+1+3 (1), 1+1+3 (3), 2+1+2 (2), 2+3+1 (1), 2+1+4 (1), 3+1+3 (1). Microbranchiospines present externally on second through fourth gill arches. Lower pharyngeal tooth-plate (Fig. 3) broad, wider than long; toothed surface cardiform. Pharyngeal teeth erect, slender, compressed, dense, only little difference in length between largest (posteromedian) and smallest (ultralateral); most teeth bevelled with distinct sharp caudad directed posterior cusp; posteriorly narrow band of hooked teeth with low anterior shelf and longer antrorse posterior cusp. Coronalis pore (NLF0) single. Five lachrymal lateralis openings; infraorbitals 2–5 absent, substituted by series of free neuromasts, infraorbital 6 (dermosphenotic) absent. Five supraorbital pores including nasal pores; 4 pterotic pores, one shared with lower of 4 extrascapular pores. Five mandibular, 2 anguloarticular, and 6 preopercular pores.

Lateral teeth in upper jaw relatively large, slightly recurved canines; anteriorly on each side a slightly enlarged stout canine tooth followed by two slightly smaller canine teeth. Inner teeth in both jaws in about two series, restricted to anterior part of jaw, very short, only tips emerging, mostly recurved, caniniform or with flattened tips much narrower than base; inner teeth close to symphysis somewhat larger and frequently tricuspid, with short lateral cusps emerging from base of median narrow tip. Lateral teeth in lower jaw very short, contrasting in size with anterior teeth comprising a large recurved caniniform tooth followed symphysially by a similar but slightly shorter tooth. Outer teeth in lower jaw procumbent, paralleling ventral head contour, but tips strongly recurved. Series of enlarged caniniform teeth in upper jaw form a curve, whereas those in lower jaw form a transverse, straight palisade. Major enlarged caniniform tooth on each side in both jaws has cusp directed slightly laterad.

Teeth (canines+smaller) in outer row hemiseries in upper jaw, 3+10 (1), 3+12 (4), 3+13 (4); in lower jaw 2+15 (1), 2+18 (1), 2+20 (1), 2+21 (2), 2+24 (1), 3+19 (1), 3+20 (1).

Vertebrae 17+18=35 (3), 18+17=35 (2), 18+18=36 (4). Single supraneural. Vertebrae contained within caudal peduncle 7 (1), 8 (8). Hypurals 2+3, and 4+5 co-ossified.

**Colour pattern in preservative (Fig. 1A).** Pale brownish on cheek, gill cover, underside of head, chest, anteriorly on abdomen; on dorsum anteriorly above lateral line fading to grey posteriorly. Front and top of head grey. Faint dark brown stripe along neuromast row below orbit. Flanks brownish or greyish brown, each scale with light margin. Dorsal fin dark grey, light dots absent or present on interradial membranes of spinous portion; lappets white with black margin; soft portion paler grey, with white margin edged with black, posterior rays with a few white dots. Caudal fin grey, lighter posteriorly; posterior  $\frac{1}{4}$  to  $\frac{1}{2}$  with many scattered white dots; posterodorsal margin, in some specimens also posteroventral margin, white with black edge. Anal fin grey, paler distally on soft portion; small white dots present or absent on interradial membranes. Pelvic fin grey with narrow white leading margin. Pectoral fin colourless. Indistinct dark pigmentation at pectoral-fin base. No sexual dimorphism in colour pattern.

**Live colouration (Figs. 4–5).** Fins bluish; dorsal fin with bright blue margin, continued on dorsal margin of caudal fin. Below eye a blue iridescent stripe. Iris and eye ring partly orange or yellow. A bluish shine forms a faint neon blue stripe along middle of side from slightly posterior to gill opening to above anal-fin origin. Epithel containing inner tooth band in both jaws yellow. The sexes share same live colouration. No variation in colour pattern has been observed in *C. cyanophleps*. At a few localities (Mvuna Island, Kisi Island, and Kalala Island) juveniles were observed together with adults. Their colour pattern was similar to the adult, but in addition a few dark brown vertical bars were visible.

**Comparative morphometrics.** Comparative morphometry was conducted on eight specimens of *C. cyanophleps* (Table 1) and 14 specimens of *C. brichardi* (Table 2). One specimen of *C. cyanophleps* (NRM 59606) was excluded from morphometric analysis as it shows signs of stunting. The standard length span is non-overlapping. All *C. cyanophleps* are longer (103.3–129.3 mm SL) than the *C. brichardi* (62.3–94.2 mm SL), and

biplot analyses do not exclude the possibility that proportional differences between the two samples may reflect the different length spans. In proportions, the stouter appearance of *C. brichardi* and more slender appearance of *C. cyanophleps* is reflected in caudal peduncle proportions (Tables 1–2: depth 11.6–12.4 % SL in *C. brichardi* vs. 9.9–10.7% in *C. cyanophleps*; length 15.3–17.4 % SL in *C. brichardi* vs. 16.9–20.3 % in *C. cyanophleps*). The Principal Component Analysis (Fig. 6, Table 3) separates the two species by body depth, preorbital depth, lower jaw length, pectoral-fin length, and caudal peduncle length. These are also measurements that show considerable individual variation, especially within *C. cyanophleps*. Field observations suggest that *C. cyanophleps* can reach total lengths of about 18 cm, whereas *C. brichardi* only reaches about 14 cm total length.

**TABLE 2.** Standard length (in millimetres) and proportional measurements in percent of standard length of *Chalinochromis brichardi*. SD= standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimetres.

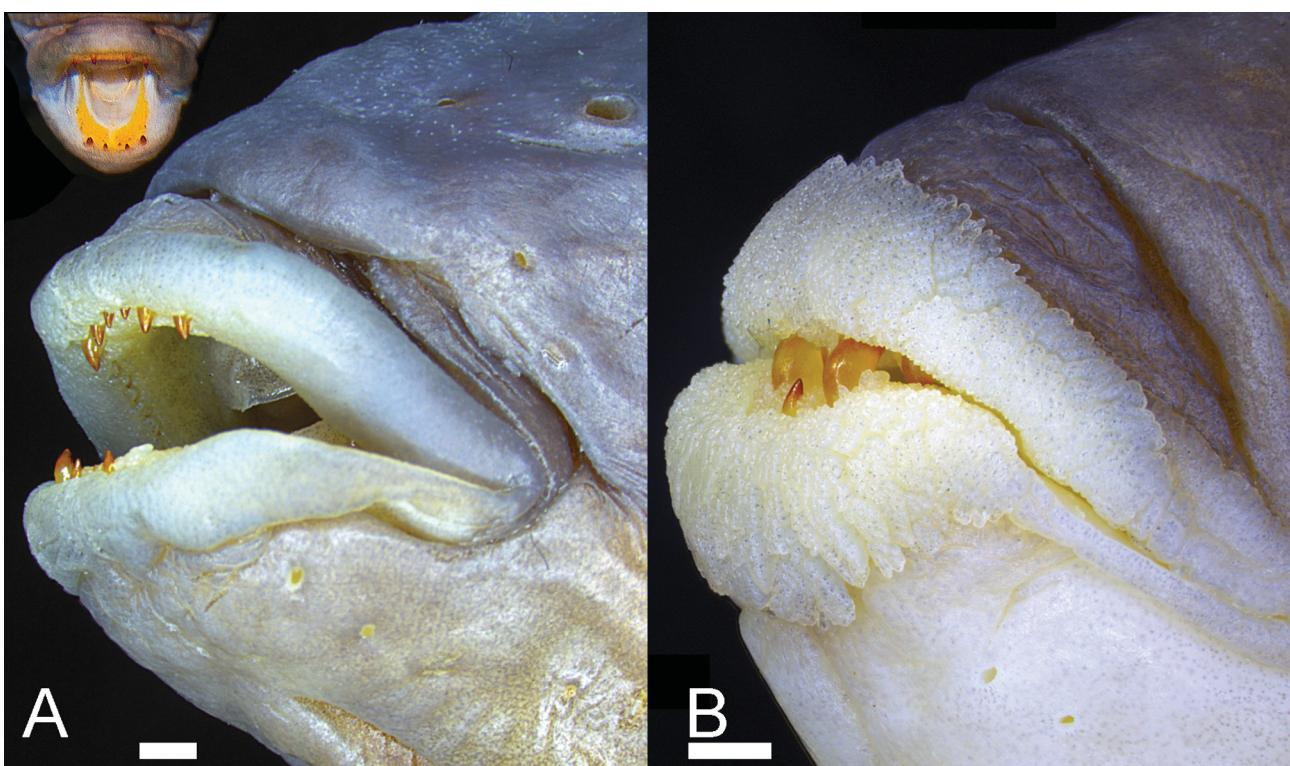
	N	Min	Max	Mean	SD	r	a	b
SL (mm)	14	62.3	94.2	77.3	9.3			
Head length	14	30.5	32.2	31.3	0.4	0.995	-0.125	0.314
Snout length	14	12.4	13.9	13.2	0.5	0.976	-1.797	0.156
Preorbital depth	14	6.3	7.4	6.8	0.4	0.972	-1.687	0.091
Body depth	14	23.9	27.9	26.3	1.0	0.986	-4.307	0.320
Orbital diameter	14	7.5	8.6	7.8	0.3	0.974	1.495	0.059
Interorbital width	14	8.1	10.3	9.3	0.5	0.939	-1.265	0.110
Pectoral-fin length	14	20.2	24.1	22.8	1.0	0.943	-0.694	0.237
Upper jaw length	14	7.9	9.5	8.5	0.4	0.949	-1.578	0.105
Lower jaw length	14	7.0	7.7	7.3	0.2	0.973	0.947	0.069
Caudal peduncle depth	14	11.6	12.4	12.1	0.3	0.985	0.149	0.119
Caudal peduncle length	14	15.3	17.4	16.0	0.6	0.945	0.459	0.154
Last dorsal-fin spine length	14	14.5	17.0	16.0	0.7	0.944	0.459	0.154

**TABLE 3.** Variable loadings on principal components 1–3 and sheared components 2–3 from pooled morphological dataset of *Chalinochromis cyanophleps* (N=8) and *C. brichardi* (N=14).

	I	II	Sheared II	III	Sheared III
SL (mm)	0.272	-0.029	-0.079	-0.082	-0.081
Head length	0.27	0.025	-0.026	0.104	0.106
Snout length	0.296	0.153	0.092	-0.003	-0.001
Preorbital depth	0.354	0.041	-0.026	0.601	0.603
Body depth	0.214	0.523	0.465	-0.141	-0.141
Orbital diameter	0.235	-0.235	-0.271	0.085	0.085
Interorbital width	0.284	0.309	0.246	-0.097	-0.096
Pectoral-fin length	0.267	-0.037	-0.086	-0.508	-0.507
Upper jaw length	0.280	0.187	0.128	0.106	0.107
Lower jaw length	0.341	-0.462	-0.510	-0.468	-0.466
Caudal peduncle depth	0.192	0.309	0.263	-0.081	-0.081
Caudal peduncle length	0.335	-0.451	-0.499	0.299	0.300
Last dorsal-fin spine length	0.209	0.016	-0.024	0.005	0.006
Eigenvalue	0.727	0.009	N/A	0.003	N/A
Cumulative variance %	97.2	98.4	N/A	98.8	N/A



**FIGURE 1.** A *Chalinochromis cyanophleps*, holotype, NRM 11993, adult female, 113.7 mm SL. Lake Tanganyika: Namansi; B *C. brichardi*, NRM 59629, adult male, 94.2 mm SL. Lake Tanganyika: Cape Kabogo.



**FIGURE 2.** Anteroventral aspect of snout tip to show differences in lip development. Scale bars 1 mm. A *Chalinochromis cyanophleps*, NRM 59607, 111.1 mm SL, right side, reversed. B *C. brichardi*, NRM 59629, 94.2 mm SL, right side, reversed. Insert shows yellow lining of lower jaw in living *C. cyanophleps*; individual not preserved.



**FIGURE 3.** *Chalinochromis cyanophleps*, NRM 59606, 111.2 mm SL, lower pharyngeal jaw. A Occlusal aspect; B close-up of teeth in occlusolateral aspect.



**FIGURE 4.** *Chalinochromis cyanophleps* in natural habitat at Namansi, type locality, depth 8 m.

**DNA Barcode.** A 685 base-pair fragment of the mitochondrial Cytochrome *c* subunit 1 (COI) gene was obtained from NRM 59606, and is deposited in GenBank with accession number KJ418181. The fragment starts at position 37 and ends at position 721 of the COI gene, and includes the standard barcoding region of COI. The most similar published sequence (30 October 2013) is *Chalinochromis popelini* (GenBank accession number AY263867), which is 1.8% dissimilar (p-distance) to *C. cyanophleps*, corresponding to 12 nucleotide positions (numbered from start of gene): 135C→T; 249G→A; 276A→G; 330C→T; 351G→A; 360A→G; 366C→A; 369C→T; 516A→G; 540G→A; 621G→A; 696G→A.

**Etymology.** The specific name, *cyanophleps*, is a Greek adjective meaning blue-veined, and is formed from the Greek *κύανος* (blue) and *φλεψ* (vein, blood vessel), with reference to the conspicuous blue stripe below the eye.



**FIGURE 5.** *Chalinochromis cyanophleps*, breeding pair in their nest at Kisi Island, depth 12 m.

**Geographical distribution and habitats.** Known only from a small section of the Tanzanian coast of Lake Tanganyika (Fig. 7). Preserved specimens are from Namansi (Fig. 8). A diving survey in 2008 found *C. cyanophleps* along the Tanzanian coast from Mvuna Island south to Kalala Island, a stretch of about 90 km. It was observed at all the southern islands in the Kipili area (Mvuna, Lupita, Ulwile), and all islands and reefs along the coast into Kala Bay and around Kalala Island (Kisi Island, Lupote Rocks, Kashia Island, Yamsamba Island, Lwilwi Island, Kauchi Island, Semwe Rocks, Popo Rocks, and Fulwe Rocks), with the exception of Lyapinda Rocks where the habitat appeared suboptimal.

*Chalinochromis cyanophleps* is a cryptic, timorous fish occupying rocky areas with large rocks or boulders. It was observed in the darker parts of the biotope, in dark crevices and caves (Fig. 5), and was often seen swimming belly up against the roof of the cave. It was very rarely seen in open areas. It was encountered at depths between 6 and 45 m. Usually only single individuals or pairs were observed. The species was often seen together with *Julidochromis regani* and *Paracyprichromis nigripinnis*, occasionally also with *Chalinochromis* “bifrenatus”.

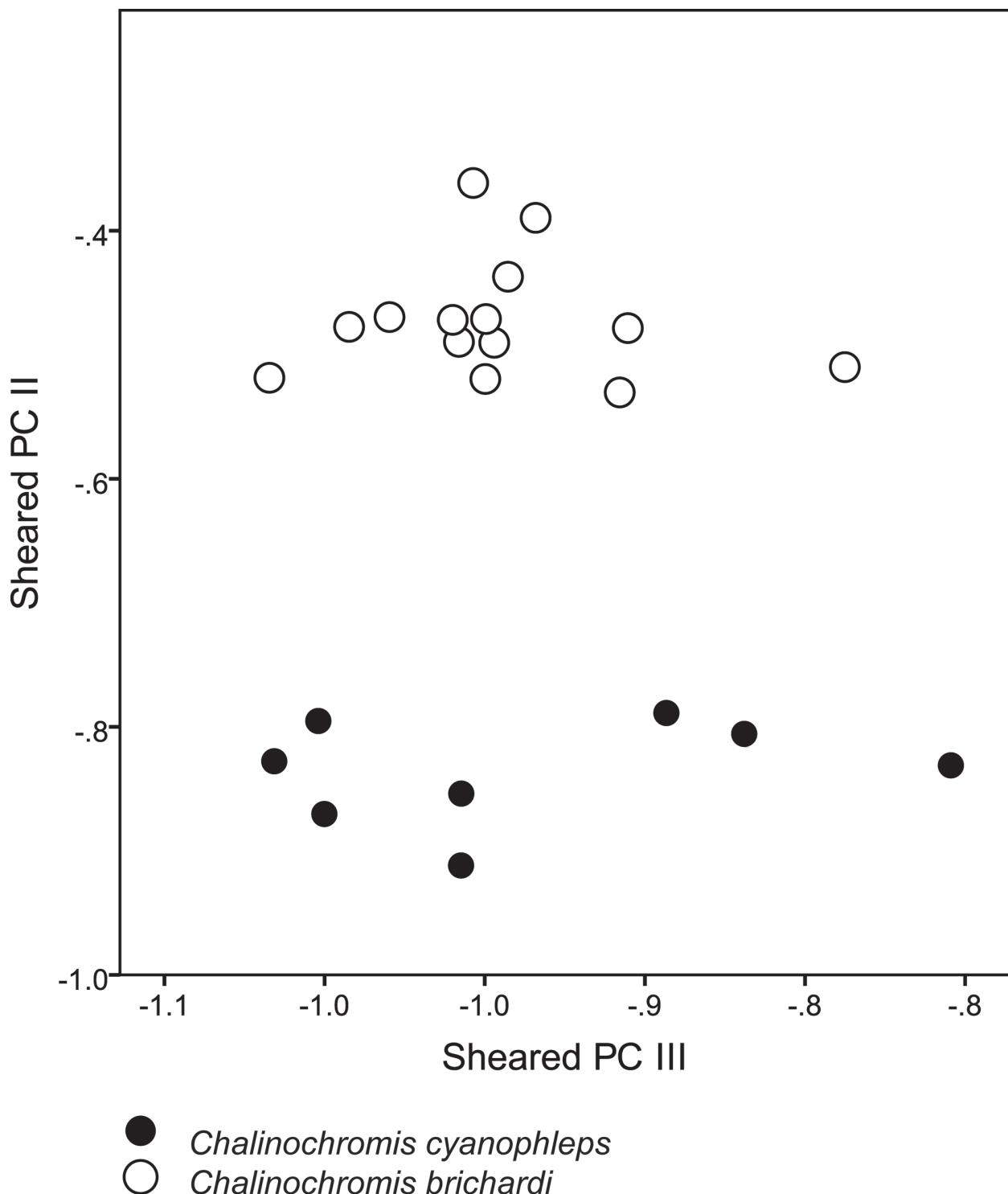
*Chalinochromis* “bifrenatus” is known to occur in the south-eastern part of Lake Tanganyika, and is sympatric with *C. cyanophleps* between Mvuna Island and Kala Bay at Lusekese, which latter is the southernmost locality for *C. “bifrenatus”* in Tanzania.

## Discussion

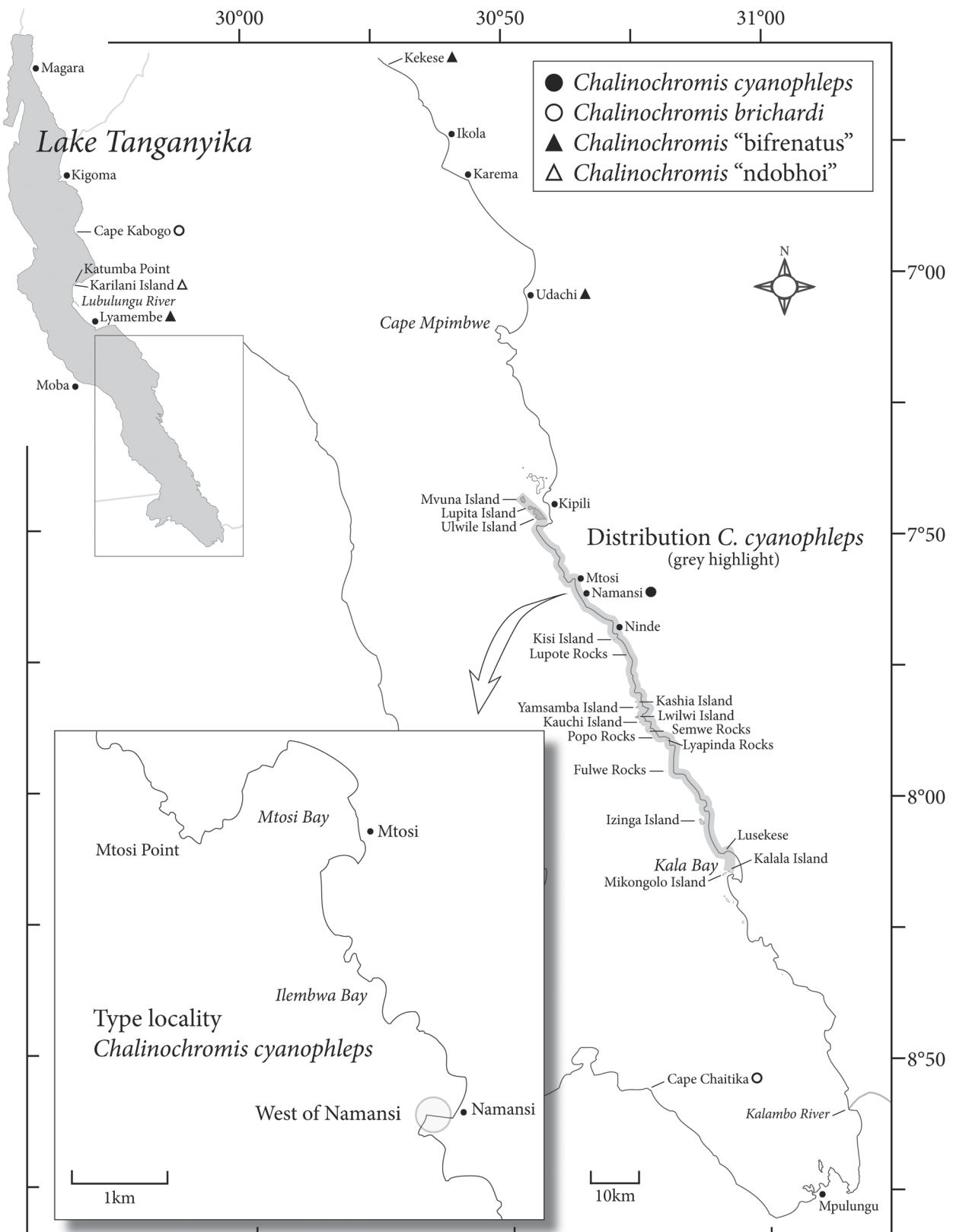
*Chalinochromis* was established as monotypic with *C. brichardi*. Poll (1974) likened it to *Julidochromis* referring to the conical teeth, un-ossified suborbitals, and elevated number of dorsal-fin spines (21–24). Regarding characteristics distinguishing from *Julidochromis*, Poll (1974) listed the head shape (profile more elevated, discontinuous), filamentous pelvic fins, imperfectly rounded caudal fin, thick, densely papilliferous lips, genital papilla invisible, particular pattern of black stripes on head, and uniform trunk colour in adult, juveniles with horizontal stripes.

This diagnosis does not properly reflect character state distributions within lamprologins, however. Unicuspid teeth and absence of ossified infraorbitals are also characteristics of *Neolamprologus*. The steep frontal contour and

sharp curve above the eyes resembles the head shape of several species of *Neolamprologus*, e.g., *N. petricola* and *N. mondabu*. Long, filamentous pelvic-fin rays are also known from some species of *Neolamprologus*, and within that genus caudal-fin shape varies from perfectly rounded to deeply emarginate with long streamers. In the specimen of *C. brichardi* figured by Poll (1974: fig. 2) the caudal fin appears damaged; in our specimens the shape varies from subtruncate to rounded. The invisible genital papilla is probably a mistake in observation; the genital papilla is well evident in all specimens of *Chalinochromis* that we have examined. The adult colour pattern is unique to *C. brichardi* only, as other species of *Chalinochromis* vary in colour pattern.



**FIGURE 6.** Scores of morphometric sheared principal component II versus morphometric sheared principal component III from pooled sample of *Chalinochromis cyanophleps* (N=8), and *C. brichardi* (N=14).



**FIGURE 7.** Outline map of Lake Tanganyika showing distribution and type locality of *Chalinochromis cyanophleps* and collecting sites of comparative material of *C. brichardi*, *C. "ndobhoi"* and *C. "bifrenatus"*.



**FIGURE 8.** Type locality of *Chalinochromis cyanophleps*, western shore of Namansi village.

The only distinguishing characters of *Chalinochromis* may thus be the expanded lips and the reduced number of teeth. Those character states are absent in *C. cyanophleps*, and the generic assignation of this species rests largely on general similarity, particularly the steep, raised frontal contour, the eye well removed from the frontal contour, the foreshortened lower jaw, and the procumbent anterior teeth in the lower jaw, but also on the elevated number of dorsal-fin spines (22–23), which is shared with *C. brichardi* (22–23, usually 23), and *Julidochromis* (22–24, rarely 21) (Poll 1956, 1986). In other lamprologins, the number of dorsal-fin spines varies between 14 and 20 with occasional records of 21 (Poll 1956, Schelly & Stiassny 2004, Büscher 1992), except for *Telmatochromis temporalis* with 19–21 (21 frequent) (Hanssens & Snoeks 2001) and *T. brachygynathus* with 20–23 (22 modal) (Hanssens & Snoeks 2003). We did not perform a full osteological review of *Chalinochromis* but note that *C. cyanophleps* has five rather than four dentary lateralis foramina, the latter number a derived character among lamprologins (Takahashi 2003) and found in all *Chalinochromis* except *C. cyanophleps*. Preliminary data from DNA analyses unequivocally place *C. cyanophleps* with other *Chalinochromis*, and the ND2 sequence of *C. cyanophleps* is most similar to that of *C. "Kipili"* in Sturmbauer *et al.* (2010).

Lamprologini is a well-corroborated monophyletic group in morphological and molecular phylogenetic analyses (Day *et al.* 2007; Stiassny 1997; Sturmbauer *et al.* 2010; Takahashi 2003). Morphology-based genera, mainly based on the work of Poll (1986), are not all recovered in molecular analyses, however, and particularly *Neolamprologus* comes out paraphyletic (Day *et al.* 2007; Sturmbauer *et al.* 2010). The interrelationships of *Neolamprologus*, *Chalinochromis*, and *Julidochromis* are clearly in need of further analysis.

In the morphology-based phylogenetic analysis of Takahashi (2003) *Chalinochromis brichardi* and *Julidochromis ornatus* are recovered among lamprologins as sister taxa based on one unique character (short anterior ceratohyal and rectangular interhyal without cartilaginous tips), and one rare homoplasy (dentary lateralis foramina reduced from 5 to 4), both characters apparently associated with a foreshortening of the lower jaw. In the molecular analyses of lamprologin cichlids by Day *et al.* (2007) and Sturmbauer *et al.* (2010), *C. brichardi*, *C.*

*popelini*, *C. "ndobhoi"*, and *C. "Kipili"* [= *C. "bifrenatus"*?], are nested, but not monophyletic, in a clade also including *Julidochromis ornatus*, *J. dickfeldi*, and *J. transcriptus*.

We have not examined specimens of *Chalinochromis popelini*. The original description of *C. popelini* (1989: 286) is restricted to the key to species of *Chalinochromis*, two photos, occasional comparisons with *C. brichardi* in the description of the genus. Thus there is no mention of type material or geographical distribution. Specimens from Moba on the Congo coast of Lake Tanganyika, were, however, deposited as holotype and paratypes in the collection of the Royal Museum for Central Africa, Tervuren. The distinguishing characters were the emarginate ("lyretail") caudal fin, and the colour pattern with two dark stripes along the side and one along the base of the dorsal fin. In *C. "bifrenatus"*, two lateral stripes are present. In populations of *C. "bifrenatus"* at the coast south of Lubulungu River and further south to Ikola, including the populations at Lyamembe and Kekese, there is no dark stripe along the dorsal-fin base, but at Karema and south to Lusekese in Kala Bay, a third dark stripe along the dorsal-fin base is visible, sometimes only faintly (pers. obs.). As obvious from Brichard's photographs, *C. popelini* is distinguished from all other species of the genus by having a large dark spot at the base of the caudal fin.

Juvenile *Chalinochromis brichardi* possess two dark horizontal stripes. With increasing size the stripes are gradually fragmented into dark elongate blotches. In populations around Karilani Island (from Katumba Point south/southwest to little north of Lubulungu River), adults retain a blotched pattern. These populations have been recognized as a separate species, 'ndobhoi' (Konings 1998). A form occurring on the Tanzanian coast, with light ground colour, two dark narrow stripes along the side, and rounded caudal fin, has been recognized in the aquarium hobby as "Chalinochromis bifrenatus". Brichard (1989) included it in *C. brichardi*, and Konings (1998) identified it as *C. popelini*. Although the trunk and fin colour pattern differs considerably between *C. brichardi* as described by Poll, and the "ndobhoi" and "bifrenatus" forms, the dark markings on the head are similar, and the remaining morphology, including the callous lips and reduced dentition appears to be shared.

Konings (1998: 102; 104, figs. 6–7) illustrated specimens of *C. cyanophleps*, identifying them as *C. popelini*, and commented that sub-adult specimens are indistinguishable from *C. popelini*. His *C. popelini*, however, includes the Tanzanian form with two horizontal stripes but no caudal-fin blotch (*C. "bifrenatus"*) (Konings 1998: 102; 104, fig. 5), and more recently Konings (2013) considered *C. cyanophleps* as a distinct species, nicknamed *C. "patricki"*.

*Chalinochromis cyanophleps* differs from all other *Chalinochromis* in its overall colour pattern and dentition. Particularly, it has a larger mouth with more teeth, and thinner lips. In *C. brichardi* the mouth is small and narrow and in preserved material the lower jaw is fixed in position unlike in *C. cyanophleps* in which it is articulating. The lips of *C. brichardi* are thick and conspicuously papillose (Fig. 2B), and the dentition dominated by the anterior large canine teeth. The inner teeth are very small, and there is no row of teeth continuing the enlarged canines along the dentary margin, except occasionally one. Other forms of *Chalinochromis* are similar to *C. brichardi* in this regard, but *C. popelini* from the type locality were not available for examination, and the lips are not as prominent in *C. "bifrenatus"*. The blue line below the eye is a conspicuous marking in *C. cyanophleps*, but a similar blue stripe, narrower, and less conspicuous, is recorded from several other lamprologins, including *C. brichardi*, and species of *Telmatochromis*, *Neolamprologus*, and *Lepidiolamprologus* (cf. images in Konings 1998).

Tricuspid teeth are a common character among non-lamprologin African cichlids, but among lamprologins it was known only from *Telmatochromis*, in which the outer row consists of unicuspisid canine teeth, and the inner rows of teeth of tricuspid teeth. In *C. cyanophleps* the tricuspid teeth are mixed with intermediate shape teeth and unicuspisid teeth, and the condition is thus intermediate between the condition in *Telmatochromis* and that in other lamprologin cichlids. Tricuspid teeth were not observed in any other species of *Chalinochromis*.

*Chalinochromis cyanophleps* adds to other dark-coloured lamprologins in the Kipili area, frequenting the rocky habitats and frequently seen swimming upside down in crevices. In colour, elongate shape and behaviour it resembles both the sympatric *Neolamprologus timidus*, and *N. furcifer*. *Neolamprologus timidus* is endemic to the same area, and the *N. furcifer* reported from Ulwile have a more rounded or heart-shaped caudal fin than typical *N. furcifer* from elsewhere which have a lyrate caudal fin (Kullander *et al.* 2014). Although the similarities might reflect mimicry, no interactions were observed between these species. *Neolamprologus* includes several more dark-coloured species, and species of *Telmatochromis* are dark-coloured. Within all three genera, however, there are also species with light ground colour and two or three dark stripes along the side. *Chalinochromis brichardi* is also associated with the rocky habitat but unlike *C. cyanophleps* it is not very shy. It is often seen in open areas, and also in mixed habitats with sand and gravel bottoms, which are not frequented by *C. cyanophleps*.

## Comparative material

*Chalinochromis* “bifrenatus”. NRM 11896. 11, 62.1–92.8 mm SL. Tanzania, Lake Tanganyika, Lyamembe. 6°27'27"S, 29°55'7"E. 15 Nov. 2012.—NRM 59567. 12, 84.7–107.4 mm SL. Tanzania, Lake Tanganyika, Udachi. 7°3'30"S, 30°33'10"E. 29 May 2008.—NRM 61032. 1, 84.5 mm SL. Tanzania, Lake Tanganyika, Ikola, Kekese. 6°36'53"S, 30°17'31"E. 6 Dec. 2008.

*Chalinochromis brichardi*. NRM 59629. 12, 62.3–94.2 mm SL; NRM 61562. 1, 81.4 mm SL. Tanzania, Lake Tanganyika, Cape Kabogo. 5°27'34"S, 29°45'2"E. 2 Jan. 2008.—NRM 61034, 1, 64.0 mm SL. Zambia, Lake Tanganyika, Cape Chaitika. 8°33'55"S, 30°47'18"E. 15 Nov. 2008.

*Chalinochromis* “ndobhoi”. NRM 59635, 12, 63.8–86.5 mm SL. Tanzania, Lake Tanganyika, Karilani Island. 6°1'14"S, 29°44'34"E. 13 Jan. 2008.

Additional comparative material as listed in Kullander *et al.* (2012, 2014).

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